RCRA CORRECTIVE MEASURES STUDY REPORT

DRAFT

BAYER MATERIALSCIENCE LLC
NEW MARTINSVILLE, WV

EPA ID WVD056866312

URS PROJECT NO 41785872

PREPARED BY

URS
POTESTA

Bayer MaterialScience

FEDERAL EXPRESS

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July 12, 2006

Bayer MaterialScience LLC
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Phone: 304 455-4400

Re: CMS Report

Dear Sirs:

Enclosed for your review are three (3) paper copies of Bayer New Martinsville's Draft RCRA Corrective Measures Study (CMS) Report, along with an electronic copy on CD.

If you have any questions, please do not hesitate to call me at (304) 451-2431.

Sincerely,

Mary Ann Henderson

Mary Ann Henderson
Manager, Regulatory Compliance

URS POTESTA

DRAFT
RCRA CORRECTIVE MEASURES STUDY REPORT

BAYER MATERIALSCIENCE LLC
NEW MARTINSVILLE, WV SITE

EPA ID WVD056866312

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JULY 2006

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PREPARED FOR:

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JULY 2006

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1.0 EXECUTIVE SUMMARY

The Bayer MaterialScience LLC (Bayer) New Martinsville manufacturing facility encompasses approximately 194 acres located along the eastern bank of the Ohio River, approximately 30 miles south of Wheeling, West Virginia, and 5 miles north of New Martinsville, West Virginia (Site). The Site is bounded by the Ohio River to the west, a steep wooded hillside to the east, the PPG Natrium Plant to the north, and the small community of Proctor, WV to the south (See **Figures 2-1 and 2-2**).

The Site was first developed in 1954 to produce polyester resin. The Site location was selected to be adjacent to the PPG Industries plant immediately to the north because PPG could safely supply via pipeline the large quantities of chlorine needed for plant operations. Today, the Site is a vibrant industrial facility employing more than 600 people and infusing more than $130 Million into the region's economy through payroll, taxes and local purchases. Products from the plant are shipped by truck and rail all over the country. The nearly 1 billion pounds of materials made annually are used in myriad consumer products such as automobiles, furniture, home construction, toys, shoes, sports equipment and many other applications from food preparation to steel manufacturing. Products produced include chemical intermediates, polyurethane materials, food grade hydrochloric acid, and iron oxide pigments.

The Site came under RCRA Corrective Action when that program was mandated by the Hazardous and Solid Waste Management Amendments of 1984 (HSWA) (HSWA Permit No. WVD 056 866 312). In HSWA, Congress directed EPA to require "corrective action for all releases of hazardous constituents from any solid waste management unit[1]..." [HSWA3004(u)]. This CMS has been developed consistent with the Resource Conservation and Recovery Act (RCRA) statute (as amended) and the RCRA regulation found in 40 CFR Part 264, Subpart S, "Corrective Action for Releases From Solid Waste Management Units at Hazardous Waste Management Facilities; Proposed Rule, "July 27, 1990 Federal Register (55 FR 30798); May 1, 1996 (61 FR 19432: November 30, 1998 (63 FR 65874); (68 FR 8757); and various policy and guidance documents that EPA has issued since the 1990 Subpart S proposal.

A significant historical event unrelated to Site operations but materially affecting environmental conditions and corrective actions at the Site today was the construction of the Hannibal Locks and Dam on the Ohio River directly across from the town of New Martinsville, WV by the US Army Corps of Engineers. The work was initiated in 1967 and completed in 1975. The installation of the lock and dam increased the upstream normal pool in that area of the Ohio River by approximately 20-feet. This had the effect of increasing the normal level of the groundwater saturated zone across the Site by approximately 20-feet as well. The most significant environmental effect of this rise in the water table at the Site was the saturation of the

[1] Solid waste management units or SWMUs were defined as areas within a site, identified by various means, as potential sources of soil and groundwater contamination.

previously unsaturated lower twenty feet (+/-) of waste in the South Landfill (SWMU 1), which began operation in 1955. This increase in the Site water table created the situation where the previously placed wastes in the landfill are now in the saturated zone and therefore in contact with groundwater.

Several investigations of the Site have been conducted over the past 25 years. A Description of Current Conditions (DOCC) Report prepared in 1997 pursuant to the RCRA Corrective Action process summarized key findings of those previous investigations to serve as a baseline for subsequent data gathering and analysis during the RCRA Facility Investigation (RFI) to follow. The DOCC summarized all available information regarding all of the Solid Waste Management Units (SWMUs) previously identified and justified their inclusion in, or exclusion from the RFI. The DOCC identified thirty (30) SWMUs to be included in the RFI.

The RFI was conducted in three phases between 1995 and 2001. The report on the third and final phase of the RFI was submitted December 2001 and approved by EPA on October 13, 2004. The RFI focused on evaluating the thirty (30) SWMUs and collecting data to support the next phase in the RCRA Corrective Action process, a Site Corrective Measures Study (CMS), the subject of this report.

The RFI determined that there were no unacceptable risks associated with the direct exposure pathway for any of the thirty (30) SWMUs and that no-further action was needed to address that potential exposure pathway. The RFI further concluded that sixteen (16) of the thirty (30) SWMUs were to be evaluated in the CMS for site-wide groundwater, pursuant to each SWMUs potential to leach constituents of interest (COIs) to groundwater at potentially unacceptable concentrations.

Lead responsibility for Agency oversight of the RCRA Corrective Action process at the Site began to transition following completion of the RFI in October, 2004. In 2004, the WVDEP received EPA authorization to carry out the RCRA Corrective Action Program statewide. The Bayer Site is one of thirty-three (33) RCRA Corrective Action facilities within West Virginia. The WVDEP decided that initially, the WVDEP Division of Waste Management (DWM) would transitionally assume responsibility for Corrective Action oversight at ten (10) of the thirty three (33) facilities in the state. The Bayer Site was among those 10 selected for the initial transfer. The DWM is currently the lead oversight Agency for the Site with EPA involvement continuing.

The CMS entails identification and evaluation of Corrective Measures alternatives for the Site and recommends a best-balanced Corrective Measures alternative. Preliminary to conductance of the CMS, the Corrective Action Objectives (CAOs) to be attained by the Corrective Measures to be identified in the CMS were defined and approved by the Agencies. In summary, the long-term CAOs for the Site are:

- Prevention of unacceptable human exposure to contaminated soils at all levels, with "unacceptable exposure" defined as carcinogenic risks > $1X10^{-6}$ and a Hazard Index for non-carcinogenic risks of > 1;
- Prevention of unacceptable human exposure to contaminated groundwater on-site and off-site with "unacceptable exposure" defined as above;
- Control of the migration of contaminated groundwater to a level that is protective of surface water quality, with "protective" defined as contamination levels in groundwater that are ≤ applicable WV Surface Water Quality Standards at the point of compliance (POC), with the POC defined as the Site boundary, and;
- Reduction of groundwater contaminant levels at the POC over time and as practicable to support reasonably expected use.

The CMS Work Plan was approved August 12, 2005. The CMS identifies twenty one (21) potential Corrective Action technologies to address site-specific environmental concerns. The technologies involve a full range of potential corrective actions for the SWMUs including: removal, in-situ and ex-situ treatment, containment and institutional controls. Potential technologies for groundwater included natural attenuation, physical and hydraulic containment barriers, passive treatment walls, collection trenches and institutional controls. The initial list of twenty one (21) potential technologies was narrowed to a list of twelve (12) technologies for a more thorough evaluation. The list of technologies was reviewed with the Agencies and approved.

Six (6) Site Corrective Measures Alternatives were developed from various combinations of the potential Corrective Action technologies. All of the alternatives were assessed to be capable of meeting the approved Site CAOs and the proposed media-specific cleanup goals. Estimated present values of the alternatives range from $12 Million to $22 Million. A best-balanced alternative was selected and recommended from among the five alternatives, based on a comparative analysis of their abilities to provide protection of human health and the environment; their short-term and long-term effectiveness; their ability to reduce toxicity, mobility or volume of contaminants; implementability; costs; and community and State acceptance. The recommended Site Corrective Measures Alternative was further evaluated with respect to its consistency with statutory requirements related to protection of public health and the environment, cost effectiveness and preference for treatment as a primary element; and the consistency of the alternative with RCRA guidance and with recent Region 3 precedent.

Key premises for, and features of, recommended Site Corrective Measures are as follows:

- Site use will remain industrial.
- Institutional Controls will be an important protective element of the Corrective Measures.

- Development and implementation of site-specific, cost effective on-site treatments to address sources of contaminants in Site Soils that may leach to Site Groundwater will be key to improvement of the contaminant levels in Site Groundwater.
- Long-term containment of Site Groundwater will be required during the lengthy period of time needed to improve Site Groundwater quality.
- Protection of human health and the environment will be maintained and assured for the long-term throughout implementation of the Corrective Measures and confirmed on an on-going basis by performance monitoring at the POC.
- The goal for the recommended Corrective Measure is the attainment of Site CAOs and media-specific cleanup objectives.

The estimated present value of the recommended Site Corrective Measures is $12.6 Million. The implementation schedule for the proposed Corrective Measures assumes approval of the CMS in 4Q06 and projects initiation of engineering design in 1Q07 and initial installations of the measures beginning in early 2008. Implementation of Corrective Measures to address the sources of contaminants to site groundwater and to contain and improve site groundwater will continue for the long-term, as well as monitoring to confirm performance and continuing protection.

2.0 INTRODUCTION AND OBJECTIVES

The Corrective Measures Study (CMS) Report for the Bayer MaterialScience, LLC (Bayer) New Martinsville, West Virginia Facility (Site) was prepared by URS Corporation (URS) and Potesta and Associates, Inc. (Potesta), on behalf of Bayer pursuant to the CMS Work Plan which was submitted to the West Virginia Department of Environmental Protection (WVDEP) and the United States Environmental Protection Agency (U.S. EPA). The CMS Work Plan was approved by the agencies in a letter to Bayer dated August 12, 2005. This CMS is consistent with EPA's regulatory provisions contained in 40 CFR Part 264 Subpart F and the general guidance contained in contained in the Advance Notice of Proposed Rulemaking (61 FR, May 1, 1996, pg 19432-19455); the RCRA Corrective Action Plan (USEPA, 1994); the Handbook of Groundwater Protection and Cleanup Policies for RCRA Corrective Action (USEPA, April 2004); and other relevant guidance documents.

2.1 FACILITY OVERVIEW

The Bayer MaterialScience LLC (Bayer) New Martinsville manufacturing facility encompasses approximately 194 acres located along the eastern bank of the Ohio River, approximately 30 miles south of Wheeling, West Virginia, and 5 miles north of New Martinsville, West Virginia. The Site is bounded by the Ohio River to the west, a steep wooded hillside to the east, the PPG Natrium Plant to the north, and the small community of Proctor, WV to the south. **Figures 2-1 and 2-2** present maps illustrating the Site location.

Several engineering-consulting firms have conducted investigations of the facility over the past 25 years including Dames and Moore (1979), Green International (1980), GAI (1981) and Geraghty and Miller (1985, 1986, and 1988). As the initial step in the RCRA Facility Investigation (RFI) process, ICF Kaiser prepared a Description of Current Conditions (DOCC, 1995) Report that summarized key findings of the previous investigations. In the DOCC Report it was concluded that sufficient characterization of groundwater had been completed by the past investigations and the continuing groundwater monitoring activities at the Site, and that the only data needs for groundwater were related to the Corrective Measures Study (CMS). The RFI focused on evaluating thirty (30) RCRA Solid Waste Management Units (SWMUs) and collecting data to support a groundwater CMS. The final RFI report was prepared by IT Corporation (IT, 2001) and approved by EPA on October 13, 2004.

Thirty (30) solid waste management units (SWMUs) were evaluated during the RCRA Facility Investigation (RFI) (IT Corp., December 2001). The RFI evaluation process determined that all thirty (30) of the thirty (30) originally identified SWMUs passed the risk evaluation screening criteria, and warranted no further action for the direct exposure pathway. However, institutional controls to protect workers from potential exposure to subsurface soils are required at SWMUs 13, 18, 19, 22, 25 and 30. Sixteen (16) of the thirty (30) originally identified individual SWMUs are to be further evaluated in a CMS for site-wide groundwater, pursuant to the potential for each SWMU to leach constituents of interest (COIs) to groundwater at potentially unacceptable concentrations. The RFI process also resulted in Fourteen (14) of the sixteen (16) individual SWMUs remaining for evaluation pursuant to groundwater being consolidated into SWMU Groups, designated as Group A, B, C, and D. Main Plant SWMUs 21 and 27 were not included in any of the groups. Section 3.0 provides further details on the rationale and makeup of each SWMU Group and individual Main Plant SWMUs 21 and 27.

2.2 CURRENT SITE USE

The Site is currently in operation as an active industrial facility incorporating Bayer's manufacturing facilities for the production of plastics, polyurethanes, coatings and colorants. Other plant operations and support facilities are represented as well, including those for wastewater treatment, solid waste management, utilities, storm water control, plant operations and maintenance (O&M), Research and general administration. All of the SWMU Groups and individual SWMUs identified for further evaluation in the CMS are located within access controlled areas of the Site. The Site was formally designated as "Industrial" in a letter to Bayer from the U.S.EPA Region III, dated August 29, 2000, in which the agency provided the Site an approved Industrial Land Use Designation (USEPA, August, 2000).

A groundwater containment pumping and recovery treatment system has been in place and in continuous operation at the Site since 1986. A portion of the recovered groundwater is re-used by Bayer for non-contact cooling water and wash water and the remainder is sent directly to the wastewater treatment plant for biological and carbon treatment prior to discharge via the Site's permitted NPDES outfall.

An adjoining chemical facility, PPG, owns and operates a groundwater well located in the northwest portion of the Site. Groundwater pumped from this well is used by PPG for sub-surface brine deposit injection and solution pumping.

The Grandview Doolin Public Service District, located approximately one-half mile south of the Site supplies water to the town of Proctor. The District extracts groundwater from the alluvial aquifer using a Ranney well located on the eastern bank of the Ohio River. Bayer has installed monitoring wells between the Site and the Grandview Doolin well to confirm that there is no off-site migration of Site COIs via groundwater. There are also three (3) nearby residents that have wells as their source of water. Bayer analyzes the residents' wells in addition to Grandview Doolin's wells annually and has not found any evidence of contamination from Site COIs in these off-site wells.

2.3 HISTORICAL SITE USE

The Site was developed in 1954 by Mobay Corporation to produce polyester resin. Mobay Corporation changed its name to Miles, Inc. in 1992 and subsequently changed it name to Bayer Corporation in 1995. In 1956, the facility became the first in the U.S. to produce toluene diisocyanate (TDI), which is a polyisocyanate used in the manufacture of polyurethane foam products. In 1962, a polymeric isocyanate unit began production. The Site began iron oxide pigment production in 1980. Historically, several other products have been produced at the Site, most of which are used in the polyurethane production process. **Table 2-1** provides an overview of historical production operation at the Site (ICF, 1995).

Currently the Site operates three (3) production divisions consisting of plastics, polyurethanes, and coating/colorants. The plastics division produces thermo-plastics. The polyurethanes division produces polyurethane resins such as Methylene diphenyl diisocyanate, polyethers, and polyesters. The coatings and colorants division produces both aqueous and solvent based industrial coatings. There is one tenant at the Industrial Park – LANXESS that produces colored pigments from a crystallization process.

Polycarbonate was also produced at the Site from 1957 to 1982 when production was ceased (ICF Kaiser, 1995). Toluene Diisocyanate (TDI) was produced from 1956 until 2005; Iron oxide pigments manufactured from mononitrobenzene (MNB) and iron chips were produced on-site from 1980 until 2002.

Various raw materials have been utilized at the Site since operations began over fifty (50) years ago in 1954. **Table 2-2** provides a summary of the primary historical raw materials and products that have been utilized or produced at the Site (ICF, 1995).

TABLE 2-1: SITE HISTORICAL PRODUCTION AND OPERATIONS

Date	Events
1954 - 1955	Plant commenced operation to produce polyester resin; Polyester-I Facility opens
1956	Monoisocyanate, toluenediamine (TDA), toluene diisocyanate (TDI) production begins
1957	Multipurpose isocyanate produced; polycarbonate production begins
1961	Dinitrotoluene (DNT) production begins
1962	Batch production of Methylene dianiline (MDA), Mondur (MR) isocyanate and methylene diphenyl diisocyanate (MDI) begins; central HCl absorption unit installed; polycarbonate production shut down
1963	Reformer #1 isocyanate processing begins; new TDA/TDI production facility constructed
1964	Original TDA/TDI facility closed; polycarbonate production resumed
1965	Mononitrobenzene (MNB) production begins; aniline and MR-1 isocyanate production begins
1967	MDA-II production begins; nitric acid production begins, Reformer #2 isocyanate processing begins
1969	Polyol production begins; Mondur CB isocyanate production begins
1970	Polyester-II resin production begins; Texin urethane resin production begins; MDA/MR/MDI-II production begins
1971	Wastewater treatment facility opened
1978	PHD Polyol production begins
1980	Iron oxide pigment facility complete and production started
1982	TDI isomer separation process begins; polycarbonate production shut down
1983	Aniline production shut down
1986	Original polyester production unit shut down; dispersion unit opens
1987	Monoisocyanate production shut down
1988	Fluid Bed Incinerator for waste incineration put into operations
1993	Off-gas Thermal Oxidizer begins operation at the HCl plant
1994	MNB production shut down
1999	TDA, DNT, and Nitric Acid operations shut down
2002	MR-I and Iron Oxide/Aniline process shut down
2005	TDI and Coating shut down

TABLE 2-2: HISTORICAL RAW MATERIALS AT THE SITE

Raw Materials Historically Utilized at Site	Dates
Phosgene, Chlorobenzene, p-Chloroaniline, Aniline, o-Toluidene	1955 – 1987
TDI, MDI, MR, Polyols, Solvents, Glycols	1955 – 1999
DNT, Methanol, Nickel, Hydrogen	1956 – 1995
TDA, Chlorine, o-Dichlorobenzene, Carbon Monoxide (phosgene intermediate)	1956 – present
Phosgene, Chlorobenzene, Bisphenol A, Methylene Chloride	1957 – 1986
HCl from off-gas of isocyanate units	1960 - present
Toluene, Sulfuric Acid, Nitric Acid, Caustic	1961 – 1999
Formaldehyde, HCL, Caustic, Aniline	1962 - present
MDA, Chlorine, Chlorobenzene, Carbon Monoxide (phosgene intermediate)	1962 - present
Ammonia, Oxygen	1962 - present
Natural Gas, Caustic, Monoethanol Amine	1963 - present
Benzene, Sulfuric Acid, Nitric Acid, Caustic	1965 – 1994
MNB, Benzene, Methanol, Nickel	1965 – 1983
TDI, Methyl Ethyl Ketone, Xylene, Glycols, TMP	1969 – present
Ethylene Oxide, Propylene Oxide, Sucrose, TDA, Potassium Hydroxide, Glycols	1969 – present
MDI, Diols, Glycols	1970 – present
Dilute Sulfuric Acid	1979 - 1994
TDI	1982 – present
MNB, Scrap Iron	1980 – 2002
TDA, DNT, Nitric Acid	Shut down in 1999
TDI and Coatings	Shut down in 2005
Iron Oxide, Aniline	Shut down in 2002

2.4 OBJECTIVES

The objectives of the CMS are based on the previously approved CMS Work Plan and are summarized as follows:

- Develop and present Corrective Action Objectives (CAOs) for Site Soils and Site Groundwater that will serve as the basis for the subsequent evaluations presented in the CMS.
- Present a summary of Site Current Conditions.
- Develop and present the evaluation results of the potential corrective measures technologies for SWMU Groups A, B, C and D; individual SWMUs 21 & 27; and Site Groundwater, pursuant to the CAOs for Site Soils and Site Groundwater..
- Develop and present a recommended corrective measures alternative to achieve the CAOs.

2.5 CMS ORGANIZATION

The CMS Report consists of the following sections:

- **Section 1.0 – Executive Summary**
- **Section 2.0 – Introduction and Objectives**
- **Section 3.0 – Summary of Current Conditions:** This section presents a summary of the Site's physical setting, subsurface characteristics, SWMU status, environmental status and the status of on-going corrective actions.
- **Section 4.0 – Corrective Action Objectives:** This section reviews the rationale and presents the approved Corrective Action Objectives for the Site.
- **Section 5.0 – Corrective Action Technology Selection:** This section details the identification, screening and selection of potentially applicable corrective action technologies for SMWU Groups A, B, C and D; SWMUs 21 & 27; and Site Groundwater pursuant to the CAOs.
- **Section 6.0 – Evaluation and Selection of the Corrective Action Technologies:** Potentially applicable corrective action technologies are evaluated for SMWU Groups A, B, C and D; SWMUs 21 & 27; and Site Groundwater.
- **Section 7.0 – Recommended Site Corrective Measures:** Site-wide Corrective Measure Alternatives are selected, evaluated and compared, and the best-balanced alternative to achieve the Site CAOs for Site Groundwater and Site Soils is recommended.
- **Section 8.0 – References:** This section presents the references utilized during the preparation of the CMS.

- **Figures, Tables, and Appendices:** The figures, tables, and relevant appendices referenced throughout the CMS are presented in these sections.

3.0 SUMMARY OF CURRENT CONDITIONS

This section of the CMS presents a summary of current conditions at the Site related to the physical setting, subsurface characteristics, areas of concern, and environmental quality conditions. The information presented generated herein follows a review of previously generated site-specific documents.

3.1 *PHYSIOGRAPHY*

The New Martinsville Facility is situated within the Ohio River Valley at the base of the West Virginia Northern Panhandle in Marshall and Wetzel Counties, approximately 5 miles north of the city of New Martinsville, WV (see **Figure 3-1**). This area is part of the Appalachian Plateau physiographic province, described as a highly dissected plateau characterized by rugged topography, steep slopes, and strong relief, with elevations ranging from about 600 feet to more than 1,600 feet above mean sea level (ft-msl). The Ohio River receives virtually all of the area's natural drainage via tributaries, surface runoff, overland flow and groundwater discharge. Stream erosion in conjunction with weathering and mass wasting of slope materials are largely responsible for the existing topography of the region (Price and others, 1956).

Exceptions to the typical rugged topography of the region occur in areas adjacent to the Ohio River where the carving of terraces into older and higher glaciofluvial outwash deposits has created relatively level or gently inclined strips of land that tend to parallel the course of the Ohio River. These land features, commonly referred to as bottoms or bottomlands, are developed from Pleistocene glacial outwash deposits that have been down-cut by historical stages of the Ohio River. The terraces are comprised primarily of gravel, sand, and silt. Surficial sediments of lower terrace features contain increasing amounts of silt and clay, which probably represent recent floodplain deposits.

The New Martinsville Facility is located on a relatively flat bottomland referred to as Wells Bottom and is bounded by an industrial facility to the north, the Ohio River to the west, Route 2 and steeply sloped terrain to the east, and the small town of Procter, WV to the south. A 100-year flood level elevation of 641 ft-msl has been estimated for the Wells Bottom region. The Ohio River has a reported mean flow rate of 24,000 cubic feet per second (cfs) and a low flow rate of 5,300 cfs. The Hannibal Dam, located downstream in New Martinsville, controls the water level and keeps river pool elevations between 620 and 624 ft-MSL during normal flow periods. The water quality of the Ohio River is reported to be suitable for many industrial uses.

Figure 3-1 shows a base map of the New Martinsville Site. **Figures 3-2 and 3-3** present two (2) recent aerial views (circa 1996) depicting the overall industrial setting of the Site along with the surrounding land. **Figure 3-2** is annotated to show the various entities/properties present in the land surrounding the Site. **Figure 3-3** is annotated to depict the general locations of the various SWMUs or SWMU Groups at the Site as well as to depict recent surface/drainage modifications at the Site. The recent changes primarily address the rerouting of the Beaver Run Stream and backwater previously located immediately adjacent to SWMU Group A. Beaver Run Stream was rerouted by Bayer in 2004 and Beaver Run Stream and the associated backwater pond were filled. The hatched areas in **Figure 3-3** depict the previous location of the Beaver Run Stream and backwater pond and the highlighted area presents the current location of the rerouted Beaver Run Stream.

Groundwater constitutes an important source of water supply in the New Martinsville area. The main water-bearing unit, the Ohio River Valley Alluvial Aquifer, is composed of the medium to coarse sand and gravel outwash deposits. Yields from this aquifer range from 100 to several thousand gallons per minute (gpm) and natural water quality is generally good (Price and others, 1956).

Climate in the area is typical of a temperate continental zone with warm summers and cold winters averaging 73 F and 34 F, respectively. Precipitation is ample and fairly well distributed throughout the year, averaging approximately 43 inches per year, with maximum and minimum rainfall occurring in summer and fall, respectively (Soil Conservation Service (SCS), 1960).

3.2 *SITE GEOLOGY*

The Northern Panhandle region of West Virginia is underlain by Paleozoic-age sedimentary rocks consisting mainly of conglomerates, sandstones, siltstones, shales, fresh-water and marine limestones, coals, and lesser amounts of chert, iron ore, and rock salt and other evaporates (Price and others, 1956). Coal deposits, which mainly occur in Pennsylvania-age and, to a lesser extent, Permian-age rocks, are a very important natural resource of the Ohio River Valley area. Rock salt and natural brines of Silurian-age strata are of local importance to chemical industrial for the manufacture of chlorine, bleaches, and caustic soda (Geraghty & Miller, 1985a).

In the hilly, more elevated areas of the Panhandle, rock units are generally overlain by a thin to moderately thick layer of residual soils from varying thicknesses that have been formed in place by the disintegration of underlying rocks and by the accumulation of natural organic material. These soils are usually relatively fertile and well drained, and are capable of supporting woodland, cropland, and pasture (SCS, 1960). Owing to the hilly topography characterizing these upland areas, the soils tend to be fairly susceptible to erosion (Geraghty & Miller, 1985a).

In areas adjacent to the Ohio River, steep valley walls with outcropping rocks of Pennsylvanian and Permian-age descend to relatively flat-lying bottomland alluvial deposits. Owing to down-cutting by the Ohio River, alluvial deposits commonly exhibit a stepped (or terraced) topography with the highest surface elevations occurring near the valley wall and successively lower elevations occurring toward the river. Throughout the southern half of Wells Bottom, surficial sediments are composed of fine sands, silts, clays, and mixtures of these, probably representing floodplain deposits laid down by the Ohio River. In areas adjacent to the valley wall, unconsolidated deposits pinch out against bedrock strata and are capped with colluvium (clay, silt, and rock fragments) derived from weathering and mass-wasting of highlands and the valley wall (Geraghty & Miller, 1985a). The colluvium tends to thin toward the river.

Fine-grained surface deposits are underlain by a thick, continuous body of glacial outwash composed of medium to coarse sand and gravel. These coarse-grained deposits, which aggraded the Ohio River Valley during retreat (i.e., melting) of Pleistocene-age glaciers, form the main water-bearing unit of the alluvial aquifer (Geraghty & Miller, 1985a).

Outwash deposits are underlain by Paleozoic-age bedrock, which is encountered beneath the Facility at depths generally not exceeding 70 feet below ground surface (ft-bgs). The buried bedrock surface slopes steeply away from the valley walls and flattens-out beneath central and near-river areas of the bottomland, forming a large U-shaped trough (i.e. the Ohio River Valley) (Geraghty & Miller, 1985a).

3.3 *SITE HYDROGEOLOGY*

The Ohio River Valley Alluvial Aquifer is comprised of glacial outwash derived sand, silty- to sandy- clay and gravels deposited on a bedrock base and represents the main aquifer beneath the Wells Bottom area. Most sand and gravel materials beneath Wells Bottom are thought to represent outwash that aggraded to the Ohio River Valley during retreat of the Pleistocene glaciers. The Ohio River Valley Alluvial Aquifer is hydraulically connected with the Ohio River throughout Wells Bottom, and is capable of yielding millions of gallons of groundwater per day with sustained pumping. If extraction wells located adjacent to the river are pumped at a high enough rate for sustained periods of time, it is possible to reverse the natural groundwater flow gradient, which normally would be toward the Ohio River.

Finer grained silty and sandy clay commonly cap or overlies the glacial sand and gravel. An accumulation of finer sediments adjacent to the Ohio River represent recent deposition of floodplain alluvium. Silty to sandy clay deposits underlying the upper tiers of Wells Bottom represent deposition of locally derived colluvium and detrital materials from weathering and mass wasting of uplands and valley walls. Discontinuous zones of shallow perched water occur sporadically throughout the fine-grained flood-plain and colluvial materials, which, constitutes a discontinuous aquitard to the downward percolation of recharge waters.

Beneath Wells Bottom, the alluvium is underlain by Paleozoic-age bedrock at depths ranging from between approximately 50 to 100 ft-bgs. The upper 100 feet of bedrock generally consist of shale and competent limestone. The bedrock surface dips from east to west from the valley wall toward the Ohio River. Yields from bedrock wells are typically low [e.g. 15 galls per minute (gpm) or less] and the quality of bedrock water is considered poor due to elevated concentrations of total dissolved solids (Geraghty & Miller, 1985).

Figures 3-4 through 3-7 present graphical representations of the generalized conceptual site model (CSM) for the Site. **Figures 3-4 & 3-6** present conceptual North-South cross sections through the Site for SWMU Group A and SWMUs within the main plant area respectively, illustrating the generalized geology at the Site, consisting of fill and fine-grained alluvial deposits overlying the coarser glacial sand/gravel alluvial aquifer and the underlying bedrock unit. Also depicted in the figures is the generalized nature of Site Groundwater.

The alluvial aquifer is generally present everywhere beneath the Site and is the focus of the current site-wide groundwater pump and treat recovery system. **Figures 3-4 & 3-6** also illustrate the general locations of the various SWMUs or SWMU Groups with respect to the site conditions. In general, with the exception of SWMU Group A, the SWMUs or SWMU groups are typically limited to the overlying fill and fine-grained alluvial deposits above the water table of the alluvial aquifer. **Figures 3-5 & 3-7** present conceptual East-West cross sections through the Site for SWMU Group A and SWMUs within the main plant area respectively, illustrating the same features as discussed for **Figures 3-4 & 3-6**. Perched water is intermittently found in discontinuous lenses across the Site, primarily in the area of SWMU Group A (i.e. in the southern portion of the Site). Perched water has a fairly direct response to recharge events and tends to be subject to short-term fluctuations in water levels.

3.4 *SUMMARY OF SOLID WASTE MANAGEMENT UNITS (SWMUs)*

Between 1985 and 1988, six (6) reports were completed in an effort to identify all SWMUs at the Site under the HSWA Permit and Administrative Consent Order (ACO). The first report identified thirteen (13) SWMUs as part of the RCRA Part B Permit Application procedure. A subsequent Preliminary Assessment Report (PAR) (SAIC, August 1986) divided these thirteen (13) SWMUs into forty-two (42) separate SWMUs and added eighteen (18) additional SWMUs, bringing the total to sixty (60) SWMUs. The PAR indicated that eighteen (18) of the sixty (60) SWMUs did not require corrective action and further noted that six (6) SWMUs required RCRA closure. Of the remaining thirty-six (36) SWMUs, twenty (20) were identified under the ACO, nine (9) were identified as requiring additional investigation to determine if corrective action was required, and seven (7) SWMUs were identified as requiring remedial investigation or immediate corrective action.

The 1987 Waste Accumulation Areas Report (Geraghty & Miller, December 1987), completed to satisfy HSWA requirements, identified seventy (70) Solid Waste Accumulation and Staging Areas or sites. Of these, fifty-three (53) sites were recommended for no further action (NFA); eight (8) sites were recommended for surface cleaning; and nine (9) sites were recommended for further study. The eight (8) sites were addressed via surface cleaning and approved as clean by the U.S.EPA on March 31, 1988 with no further action required. The fourth report, the Existing Process Trench Report (IT Corporation, June 1988), recommended additional studies for the existing process trench area.

The RCRA Facility Assessment (RFA) was the fifth report and was submitted to the U.S.EPA on June 28, 1998, in accordance with HSWA requirements. The RFA reviewed the nine (9) sites identified in the Waste Accumulation Areas Report and four (4) additional sites specified in the HSWA Permit. Of the thirteen (13) sites addressed in the RFA, two (2) were being investigated under the ACO, seven (7) were recommended for NFA, and four (4) sites were recommended for further study. The June 1988 Procedures and Results of Investigation Report identified twenty-three (23) SWMUs and recommended further study for these units. Of all the SWMUs identified for the Site, thirty (30) were ultimately recommended for inclusion in the RCRA Facility Investigation (RFI).

The final RFI report was prepared by IT Corporation (IT, 2001) and approved by EPA on October 13, 2004. In the approved RFI, thirty (30) SWMUs were evaluated using a screening risk assessment process that included comparison of media constituents to USEPA Region III Risk-Based Concentrations (RBCs) for industrial and residential uses or the USEPA Region III Soil Screening Levels (SSLs). On-site worker exposures were evaluated for the upper 2 ft soil interval, and onsite construction worker exposures were evaluated for the 0-5 ft soil interval. Soil constituents at all depth intervals were compared to the SSLs. The SSLs were used as screening criteria to assess the potential to leach contaminants to groundwater. Site-Specific SSLs were calculated to further evaluate if constituents within the unsaturated zone at levels exceeding SSLs could potentially migrate to groundwater at concentrations of concern.

In addition, constituents of interest (COIs) were identified. COIs are defined as constituents whose detected concentrations exceeded the respective RBC(s). COIs were evaluated in the RFI for carcinogenic or non-carcinogenic risks to on-site workers, depending on the nature of the specific chemical compound.

The RFI evaluation process resulted in all thirty (30) SWMUs being recommended for no further action based on the risk screening evaluation. However, the RFI further concluded that sixteen (16) of the thirty (30) originally identified individual SWMUs be further evaluated in a CMS for site-wide groundwater, pursuant to their potential to leach COIs to groundwater at potentially unacceptable concentrations. The RFI process also resulted in the sixteen (16) individual SWMUs being consolidated into SWMU Groups, designated as Group A, B, C, and D, and individual SWMUs 21 & 27 as follows:

(1) SWMU Group A (SWMUs 1-4)
(2) SWMU Group B (SWMUs 5 and 6)
(3) SWMU Group C (SWMUs 7, 8, 9 and 11)
(4) SWMU Group D (SWMUs 10, 12, 15 and 16)
(5) SWMU 21
(6) SWMU 27

The locations of the various SWMUs / SWMU Groups, as outlined above, are presented graphically in **Figure 3-1**.

RFI Table 8-1 summarized conditions and the recommendation status for the individual SWMUs and SWMU Groups. **Table 3-1** presents the information contained in RFI Table 8-1 for these SWMUs and SWMU Groups.

3.5 *GROUNDWATER QUALITY SUMMARY*

The main aquifer beneath the Bayer facility is the Ohio River Valley Alluvial Aquifer. The alluvial aquifer beneath the Bayer facility consists generally of an elongated lens of up to 20 feet of fine sand with varying amounts of silt overlying a medium to coarse sand and fine gravel outwash deposit that averages 20 to 30 feet in thickness. The base of the alluvial aquifer extends to the top of bedrock, which is found at depths generally not exceeding 70 ft-bgs (Geraghty & Miller, 1998a)[2]

Localized areas of perched water are separated from the alluvial aquifer by a discontinuous silty clay 'confining layer', where natural silt and clay-rich alluvium has been overlain with more permeable fill. The RFI concluded that perched water flow is primarily in a downward direction, ultimately discharging to the alluvial aquifer. For the main plant area, lateral flow of the discontinuous perched water roughly coincides with the natural drainage pattern prior to infilling. The RFI concluded that there was some potential for perched water within the South Landfill (SWMU 1 within SWMU Group A) to discharge laterally into the Beaver Run surface water. However, subsequent to this report, Bayer has further minimized this potential by rerouting Beaver Run and infilling the original channel.

The alluvial aquifer beneath the Site is currently pumped by three (3) groundwater recovery wells, each collecting approximately 150 gpm. In addition, an adjacent industrial facility, PPG, extracts groundwater periodically from a production well on the northwest portion of the Facility. Across the facility, the aquifer drawdown is at or near the base of the overlying confining layer. The main source of aquifer recharge is from the Ohio River. The aquifer also receives recharge from overlying alluvial deposits and to a limited degree, from lateral discharges from valley wall bedrock. Under pumping conditions, groundwater flow within the alluvial aquifer is radial toward the center of the Site under the main plant area, with induced river flow becoming the main source of aquifer recharge (Geraghty & Miller, 1985a).

Groundwater sampling has been conducted at the Site since 1985 and has indicated environmental impacts to the alluvial aquifer from volatile and semi volatile organics compounds (VOCs and SVOCs). The RFI included a screening groundwater risk evaluation utilizing groundwater data available from on-site and off-site wells. Groundwater analytical results were compared to USEPA MCLs for drinking water or to USEPA Region III RBCs for tap water. Twenty-two (22) constituents in on-site wells exceeded at least one of these screening criteria. No constituents from offsite wells were in excess of the screening criteria. COIs found in the on-site groundwater consisted primarily of VOCs and SVOCs. The RFI concluded that the affected groundwater is contained on-site. More recent groundwater data from the 2003 Groundwater Monitoring Report (MFG, Inc., 2004) confirmed that the alluvial aquifer contaminant plume is stable and is being contained on-site by existing recovery well operations. Since the recovery wells were installed in 1986 all groundwater elevation readings since then have demonstrated successful and consistent plume hydraulic containment.

The primary VOCs that have been historically detected in groundwater at the Site include:

- 1,1,1-trichlorethane
- 1,2-dichlorobenzene
- 1,4-dichlorobenzene
- chlorobenzene
- benzene
- toluene
- trichloroethene
- trichlorofluoromethane

Of these eight (8) compounds, chlorobenzene, 1,2-dichlorobenzene, and benzene represent the most frequently detected VOC components.

The most frequently historically detected SVOCs within groundwater at the Site include:

- 1,2-dichlorobenzene
- 2,4-dinitrotoluene
- bis(2-ethylhexyl)phthalate
- nitrobenzene
- o-nitrotoluene

Detections of 2,4-toluenediamine, 2,6-dinitrotoluene, 4,4-methylenedianiline, 5-nitro-o-toluidine, aniline, bisphenol A, m-nitrotoluene, o,p-toluidine, p-chloroaniline, and p-nitrotoluene are also reported.

All metals analyzed have been historically detected in groundwater at the Site; however, the concentrations are generally within the ranges expected for background levels.

Perched water is impacted in various areas of the Site by both VOCs and SVOCs, particularly in the south landfill area (SWMU Group A). The migration path for the perched water is believed to be primarily downward into the alluvial aquifer.

The configuration of the plumes of total VOCs and SVOCs in the upper and deeper portions of the alluvial aquifer are similar, with concentrations in the deep portion being much lower than those found in the upper portion.

[2] Page 7-5, Final RFI Report, Revision 1, December 2001, IT Corp.

The complex intermingling and widespread distribution of organic compounds beneath the facility have resulted from historical releases from the multiple SWMUs. Changes in dominant flow directions by variations in both pumping center locations and rates throughout the plant's history have further complicated attempts to link groundwater contamination to individual sources. As a result of these factors, observed groundwater contamination characteristics cannot reliably be linked to individual SWMUs.

Groundwater within the upper bedrock is considerably more mineralized than groundwater within the alluvial aquifer. Bedrock monitoring wells also exhibit higher pH, higher alkalinity, and higher concentrations of sodium, chloride and barium than are observed in the associated deep alluvial aquifer monitoring wells (Geraghty & Miller, 1988a). These water quality trends suggest that the bedrock strata beneath the Facility have not been fully flushed of natural connate waters (i.e. waters incorporated with the sediments at the time of deposition. The occurrence of waters with similar composition at shallow depths within the Ohio River Valley bedrock strata have been recorded elsewhere (Price and others, 1956).

Organic compounds have been sporadically detected in samples from the bedrock monitoring wells. However, these low or trace concentrations have been reported as representative of false-positive results due to cross-contamination during sample collection and/or analysis, based on associated quality control sample results.

3.6 RFI SUMMARY

The media potentially affected by releases at the Site and evaluated in the RFI include soil, surface water, groundwater and sediments. The conclusions and recommendations presented in the RFI were based on the combined results of all three RFI phases. Soils were investigated on a SWMU basis during Phases 1 & 2 of the RFI and groups of SWMUs in Phase 3. The SWMUs were grouped based on proximity, historical knowledge and analytical results.

Human health risk was a critical component in the interpretation of soil, surface water and sediment data in the RFI decision process. The primary purpose of the risk assessment was to decide the appropriate corrective action to take, if any, for soil at each SWMU or SWMU group. The risk assessment considered both residential and industrial land use. However, because Bayer is an active industrial facility and has been recognized as such by the USEPA, all recommendations for corrective actions were based on the assumption of continued industrial land use into the future. The recommendations were:

- No Further Action (NFA) for surface water and sediments;
- Institutional Controls to protect workers from potential exposure to subsurface soils for SWMUs 13, 18, 19, 22, 25 and 30, and for each of the SWMUs and SWMU groups evaluated during RFI Phase 3;

- An engineered soil cover for SWMU Group A in combination with rerouting of Beaver Run to eliminate any future potential impact to surface water and potential hazards due to stream erosion.
- A CMS to define actions, if any, required to expedite groundwater quality improvement, which may include addressing potential leaching to groundwater associated with some of the Phase 3 SWMUs / SWMU groups.

3.7 Ongoing Corrective Actions

Pursuant to the RFI recommendations stated in the preceding section, the following relevant actions by Bayer were either already in progress or have been taken pursuant to the recommendations:

3.7.1 Institutional Controls

Pursuant to the RFI recommendation, Bayer has initiated health and safety work practices for on-site workers who could potentially come into contact with SWMUs or Site groundwater. Engineering controls will be installed where appropriate to prevent unsafe exposures.

3.7.2 SWMU Group A Actions

In 2004, Bayer relocated Beaver Run, an on-site tributary of the Ohio River. A portion of the stream created a backwater on the east side of SWMU Group A (i.e. near the South Landfill). The backwater pond was drained and the stream was relocated to convey water to Dry Run. A new wetland was also constructed. The former stream channel now contains a storm water drainage channel that discharges to a sedimentation basin, which discharges into the Ohio River. This action eliminated the backwater adjacent to SWMU Group A and further reduced the potential for leaching of COIs into surface water. Soil covers and fencing around SWMU Group A have been installed. A recommendation by Bayer to install an engineered soil cover on SWMU Group A contemporaneous with the relocation of Beaver Run was not approved by the Agencies.

3.7.3 Groundwater Quality Improvements & Protective Measures

Bayer has maintained groundwater recovery wells at the Site since 1986. Currently, three (3) groundwater recovery wells are in operation in the Main Plant Area, continuously extracting an average of 474 gpm (total) of affected groundwater from the alluvial aquifer beneath the Site. All recovered groundwater is treated in Bayer's on-site biological wastewater treatment facility prior to discharge to the Ohio River. Bayer's wastewater treatment discharge is regulated under an NPDES discharge Permit. In the 20 years of operation of the groundwater pump and treat system, an estimated 4.2 billion gallons of water have been extracted for treatment and 725,000 pounds of organic material have been removed from the alluvial aquifer.

Bayer performs regular monitoring of the groundwater between the Site and the Grandview Doolin Ranney extraction well one-half mile to the south to confirm that there is no off-site migration of Site COIs via groundwater. Bayer analyzes the Grandview Doolin wells annually and has not found any evidence of contamination from Site COIs. There are also three (3) nearby residents that have wells as their source of water. Bayer analyzes the residents' wells annually and has not found any evidence of contamination from Site COIs in these off-site wells.

4.0 CORRECTIVE ACTION OBJECTIVES

Corrective Action Objectives (CAOs) are general descriptions of what corrective measures at the Site are intended to accomplish. The RFI, summarized in **Section 3.0 Summary of Current Conditions**, concluded that Site areas requiring further study pursuant to this CMS are:

1. SWMU Groups A, B, C and D; SWMU 21; and SWMU 27 - relative to the potential for COIs to leach from the SWMU affected soils to Site Groundwater at concentrations of potential concern, and;
2. Site Groundwater.

Therefore, CAOs have been developed for Site Soils and Site Groundwater and approved by the Agencies. The CAOs are premised on the Site remaining industrial. The approved CAOs are shown in detail in **Table 4-1**. The CAOs are media specific and time dependent (short-term and intermediate/long-term timeframes). In summary, the CAOs are as follows:

Overall CAO:

- At all times, prevent unacceptable human exposure (carcinogenic risk > 1×10^{-6} and Hazard Index > 1) from affected Site Groundwater and Site Soils

Site Soil CAOs:

- Prevent unacceptable industrial worker exposures to shallow (0 to 2 ft-bgs) surficial soil COIs (i.e. detected contaminants),
- Prevent unacceptable construction worker exposures to subsurface (0 to 5 ft-bgs) soil COIs, and
- Prevent unacceptable construction worker exposures to soil COIs (at all depths).

Site-wide Groundwater CAOs:

- Prevent unacceptable human exposures to recovered contaminated groundwater;
- Maintain current groundwater recovery well system operation for groundwater collection and plume hydraulic containment within the Site boundary;
- Provide for the continued control of potential off-site migration of contaminated groundwater to a level that is protective of surface water quality, and;
- Implement reasonable efforts to eliminate or mitigate further releases of contaminants from SWMUs (using the site boundary as the point of compliance).

4.1 MEDIA SPECIFIC CLEANUP GOALS

Media specific cleanup goals are to be based on EPA guidance, public health and environmental criteria, information gathered during the RFI and the requirements of any applicable Federal or State Statutes. Media specific goals are site specific concentrations in a given media that a final remedy must achieve for the remedy to be considered complete (Region III Model CMS Outline). The Point of Compliance is the location or locations at which media cleanup levels are achieved (FR 61 III.C.5.d, pg 19450). The term "media cleanup levels" typically refers to site and media specific concentrations of hazardous constituents, developed as part of the overall cleanup standards for a facility. The term "media cleanup standard" refers to broad cleanup objectives; it often includes the more specific concepts of "media cleanup levels", "points of compliance," and "compliance timeframes". Media cleanup standards (and levels) should reflect the potential risks of the facility and media in question by considering the toxicity of the constituents of concern, exposure pathways, and fate and transport characteristics. (FR 61 III.C.5.c, pg 19449).

One of the four threshold criteria for remedy selection for Corrective Action is that the selected remedy "attain media cleanup standards". The attainment of media cleanup standards does not necessarily entail removal or treatment of all contaminated material above specific constituent concentrations. Depending on the site specific circumstances, remedies may attain media cleanup standards through various combinations of removal, treatment, engineering and institutional controls. For example, in situations where waste is left in place in an engineered or under a cap, media cleanup standards can be attained in part through long-term engineering and institutional controls (FR 61 III.C.5.(g).b, pg. 19449).

Consistent with RCRA Guidance discussed above where wastes will be left on site, the POC for the Bayer Site has been defined in the CAOs as the Site boundary. This approach to the groundwater POC is generally referred to as the "throughout the plume/unit boundary POC." This approach is consistent with the groundwater POC described in the preamble to the Superfund program's National Contingency Plan (NCP, page 8713 and 8753, Federal Register March 8, 1990) (FR 61 III.C.5.(g).d, pg. 19450). Therefore, the proposed "media cleanup level" for Site groundwater is focused on protection of the surface water body into which the groundwater would otherwise discharge (i.e. absent containment):

- Site related COI concentrations ≤ their respective MCL and WV Surface Water Quality Standard at the POC.

When containment is part of the final remedy, facilities and regulators are encouraged to develop systems to monitor the effectiveness of the containment (Handbook of Groundwater Protection and Cleanup Policies for RCRA Corrective Action, Final Cleanup Goals, pg. 4.6). Therefore, the following criteria are proposed as measures-of-effectiveness of the containment element of the Final Remedy:

- Periodic confirmation that no Site related COIs have reached the drinking water wells of any potential receptors, and;
- Periodic documentation of an inward gradient for the alluvial aquifer at the Site boundary.

The specific issue to be addressed by this CMS with respect to Site Soils is the potential for Site Soils associated with certain SWMUs to leach COIs to Site Groundwater in concentrations of potential concerns, based on screening of the Site Soil COI concentrations against the site specific SSLs. Site soils containing COIs in excess of the SSLs are to be addressed as a potential source for the COIs identified in groundwater. Therefore, consistent with the site-specific risks associated with Site Soils and the approved CAOs, the proposed cleanup goal for the Site is:

- Achieve reduction of Site Soil COI contaminant levels over time, as practicable, to support attainment of Site Groundwater cleanup goals.

5.0 CORRECTIVE ACTION TECHNOLOGY SELECTION

Potential Corrective Action technologies have been identified and evaluated with respect to each SWMU, SMWU Group and Site-wide Groundwater. Each potential technology has been evaluated with respect to its applicability to the facility and its potential to achieve the Site CAOs – either as a standalone technology or in combination with other technologies. A wide-range of potentially applicable Corrective Action technologies were considered, including the use of both traditional and innovative approaches. In the final recommendation, alternatives utilizing proven Corrective Action technologies will be given preference as prescribed in USEPA directive (USEPA, 1993). The array of potential Corrective Action technologies to meet the media CAOs include technologies from all of the following categories:

- **Site Soils -** Engineered covers and containment barriers; removal, with disposal and/or treatment; insitu treatment/stabilization; and institutional controls.
- **Site-Wide Groundwater -** Containment via extraction and treatment; passive treatment barriers; active in-situ treatment; and institutional controls.

To facilitate the technology evaluation and consistent with the RFI, Site SWMUs, SWMU groups and Site-wide Groundwater will be consolidated as follows:

- ➢ SWMU Group A
- ➢ Main Plant Area (SWMU Groups B, C and D and SWMUs 21 & 27)
- ➢ Site-wide Groundwater

Following are descriptions of the SWMUs within each of the consolidated areas, with relevant information pursuant to the technology screening process:

SWMU GROUP A

SWMU Group A contains the South Landfill (SWMU 1) and associated waste management areas: Sludge Lagoon (SWMU 2), Hydroblasting Station (SWMU 3) and the Ash Lagoon (SWMU 4). The SWMU Group A area is entirely within the property boundary of the Site, which has controlled access. The area of SWMU Group A is estimated to be approximately 7 acres. See **Figure 3-1.**

The South Landfill, Sludge Lagoon and possibly the Ash Lagoon, have a portion of their waste materials at or near elevation 600 feet mean sea level (ft-msl). This elevation datum is beneath the base of the alluvial aquifer confining layer in the area, which is at approximately elevation 620 ft-msl. The potentiometric surface of the alluvial aquifer is also at approximate elevation of 620 ft-msl. Historically, when the landfill was actively being used, the waste fill area was operated above the local water table. However, the water table conditions changed as a result of an approximate 20 foot rise in Ohio River pool elevation (current average 620-624 ft-msl) caused by the Hannibal Dam construction in 1973.

As discussed previously, the former Beaver Run pond on the east side of the landfill was drained, and Beaver Run was rerouted in 2004. This measure significantly reduces the potential for contaminant leaching of the SWMU lower waste deposits and a reduction in the potential for leachate migration to surface water.

Site worker exposure to contaminated soils is limited because of the isolated detections of soils containing constituents above industrial USEPA Risk-Based Concentration (RBC) levels in the upper 5 feet interval. The only constituent detected above the RBC levels was 2,4-toluenediamine (TDA). TDA was found above the RBC in only 1 of the 26 SWMU Group A samples taken in the 0-5 feet below ground surface (ft-bgs) interval.

Groundwater CAOs focus on control of migration of perched water to surface waters (short and long-term) and reduction of contaminant leaching to groundwater as part of the intermediate/long-term goal of improvement of groundwater quality. The primary chemical constituents that exceeded the USEPA Soil Screening Levels (SSLs) for leaching to groundwater included one VOC (benzene); five SVOCs (dichlorobenzenes, nitrobenzene, 2,4- dinitrotoluene, 2,6- dinitrotoluene, phenol and p-chloroaniline); and two metals (cadmium and nickel).

MAIN PLANT AREA (MPA)

The Main Plant Area (MPA) contains the remaining Site SWMUs. The MPA is within the operating boundaries of the plant, which has controlled access. The SWMU Groups and individual SWMUs within the MPA have significant similarities, including surface and subsurface conditions and contaminant types that allow potential Corrective Action technologies to be evaluated for the MPA as a whole to facilitate the CMS process. Individual differences in the SWMUs, significant to a particular Corrective Action technology evaluation, are addressed as appropriate. A brief summary of the individual MPA SWMU Groups and individual SWMUs follows (See **Figure 3-2** for the MPA location).

SWMU GROUP B

SWMU Group B is the bulk TDI residue fill area and lies underneath the Bayer Plant wastewater and storm water storage and treatment facilities. The existing facilities have either been constructed on or within fill material consisting of alluvial soils interspersed with TDI residues. The area of SWMU Group B is estimated to be approximately 10.5 acres. SWMU 5 currently contains an equalization basin, approximately 2 acres in area, and a rainwater storage lagoon, approximately 1.2 acres in area. The average depth of the basins is 20 feet. The existing Bayer Plant wastewater treatment facility includes two (2) 125-ft diameter clarifiers, two (2) 100-ft diameter aeration tanks, and other small support buildings.

The CAOs associated with SWMU Group B focus on prevention of on-site worker exposures to zones greater than 5 ft in depth and reduction of contaminant leaching to groundwater as part of the intermediate/long-term goal of improvement of groundwater quality.

SWMU GROUP C

SWMU Group C contains three relatively small areas (SWMUs 8, 9 and 11), and one large general residue fill area (SWMU 7). SWMUs 8 and 11 were former waste treatment pits, from 200-400 sf in area, ranging from 7-10 feet deep. SWMU 9 was a temporary residue storage pile area, approximately 100 by 140 feet. SWMUs 8, 9 and 11 appear to be in open, non-operations areas. SWMU 7 encompasses an approximately 4 acre area in Block 21 that includes the incinerator facilities, the fuel oil storage tank area and the other SWMUs of the group. The SWMU Group C Area has either been constructed on or within fill material consisting of alluvial soils interspersed with miscellaneous solid waste debris and TDI residues.

The CAOs associated with SWMU Group C focus on prevention of on-site worker exposures to zones greater than 5 ft in depth and reduction of contaminant leaching to groundwater as part of the intermediate/long-term goal of improvement of groundwater quality.

SWMU GROUP D

SWMU Group D encompasses the former wastewater trench (SWMU 10) and acid neutralization basin system. The trench was located in a former stream channel that run through the plant and was connected to the neutralization basins (SWMUs 12, 15 and 16). The trench segment identified as SWMU 10 contains a main branch approximately 1850 feet long, and a lateral section approximately 400 feet in length. SWMU 12 was reported to be 30 ft by 100 ft by 17 ft deep. SWMUs 15 and 16 are smaller, with dimensions of 10 ft by 30 ft and 12 ft by 12 ft by 15 ft, respectively. The depth of SWMU 15 is not known. Each of the basins were unlined pits used for acid wastewater neutralization. The trench and basins have all been backfilled.

The CAOs associated with SWMU Group D focus on prevention of on-site worker exposures to zones greater than 5 ft in depth (SWMUs 10 and 12 only), and reduction of contaminant leaching to groundwater as part of the intermediate/long-term goal of improvement of groundwater quality (SWMUs 10 and 12 only). SWMUs 15 and 16 were found to not present a risk to onsite workers since none of the soil samples in these areas exceeded the industrial RBCs. In addition, these SWMUs did not have any soil samples in exceedance of

EPA Region III SSLs, and therefore they are not considered as a potential source of contaminant leaching to groundwater.

SWMU 21

SWMU 21 is the former Nitrations Neutralization Basin 5Fc. This unit was used to treat wastewater from the Nitrations Process Area with limestone. The unit was an unlined earthen basin 30 ft by 30 ft in area. Depth is not known. Effluent was discharged to the main process trench.

The CAOs associated with SWMU 21 focus on prevention of on-site worker exposures to zones greater than 5 ft in depth, and reduction of contaminant leaching to groundwater as part of the intermediate/long-term goal of improvement of groundwater quality.

SWMU 27

SWMU 27 consists of two small areas, one located on the southeastern side of Block 27 and the other on the western side of Block 17. Two releases have been recorded in Blocks 17 and 27 from product pipelines. One release occurred on January 16, 1994 and consisted of approximately 400 pounds of benzene. The second release occurred on January 17, 1994 and consisted of approximately 150 pounds of benzene. The spilled material was collected and contaminated soils were containerized and shipped offsite for proper disposal.

The CAOs associated with SWMU 27 focus on prevention of on-site worker exposures to zones greater than 5 ft in depth, and reduction of contaminant leaching to groundwater as part of the intermediate/long-term goal of improvement.

SITE-WIDE GROUNDWATER

The Site-wide Groundwater alluvial aquifer is described in more detail in **Section 3.0 Summary of Current Conditions**. Based on a summary of all three phases of the RFI and a site-specific risk assessment incorporating the information from all three phases, the Phase III RFI drew the following conclusions relative to Site-wide Groundwater:

1. Site-wide Groundwater does not represent a current risk to human health or the environment and;
2. The existing Site-wide Groundwater recovery system provides hydraulic containment of the contaminated groundwater preventing off-site migration of dissolved phase COIs.

CAOs for Site-wide Groundwater are based on continued hydraulic containment of the contaminated groundwater (i.e. dissolved phase plume) over the short to long-term and the achievement of the following goals:

1. Prevent unacceptable human exposure to contaminated groundwater.
2. Control the migration of contaminated groundwater to a level that is protective of surface water quality.
3. Employ reasonable efforts to eliminate or mitigate further releases of contaminants from SWMUs (using the site boundary as the POC).
4. Reduce groundwater contaminant levels, as practicable, over time to support reasonably expected use.

As previously discussed, the current Site use-designation is industrial. This use-designation is anticipated to remain industrial for the foreseeable future (i.e. long-term >20 years).

Table 5-1 contains a list, along with brief descriptions, of the specific Corrective Action technologies that were considered for SWMU Group A, Main Plant SWMUs and Site-wide Groundwater. Bayer discussed each of these potential Corrective Action technologies with the regulatory agencies prior to finalization. Each potential Corrective Action technology from **Table 5-1** was screened against the screening criteria specified in the USEPA Corrective Action Plan Guidance Document, (USEPA, May, 1994) as follows:

- **Site Characteristics –** The Site's current status and conditions along with historical information was reviewed to identify Site characteristics that limit or promote the use of each technology. Technologies whose use is precluded by site characteristics were eliminated from further consideration.
- **Waste / Contaminant Characteristics –** The physical and chemical characteristics of the Site waste and COIs were assessed to determine if the potential Corrective Action technologies were appropriate. Technologies clearly limited in effectiveness by identified waste / contaminant characteristics were eliminated from further consideration.
- **Technology Limitations -** The status of technology development and performance experience with respect to Site COIs, constructability, and operation / maintenance issues were identified and evaluated for each of the potential Corrective Action technologies. Technologies that were deemed unreliable, perform poorly, or are not fully demonstrated were eliminated from consideration. Corrective Action technologies whose performance and effectiveness have been successfully demonstrated at other sites with similar COIs and site conditions will be given preference in the final recommended Corrective Measures.

Additionally, a fourth screen was added to assess the ability of each potential Corrective Action technology to achieve the Site CAOs related to that particular area (i.e. SWMU Group A, MPA or Site-wide Groundwater).

5.1 IDENTIFICATION OF POTENTIAL CORRECTIVE ACTION TECHNOLOGIES

Based on the initial screening criteria several potential Corrective Action technologies for SWMU Group A, the MPA and Groundwater Areas at the Site were retained for further evaluation. Those potential Corrective Action technologies retained through this initial screening criteria evaluation will be incorporated into a more detailed analysis of potential Corrective Action technologies for SWMU Group A, MPA and Site-wide Groundwater in Section 6.0 and assembled into Site Corrective Measures Alternatives and evaluated in Section 7.0.

Tables 5-1 presents a list and a description of the various technologies that were evaluated for potential use as components of a final Corrective Measure alternative. The results of this initial screening of potential Corrective Action technologies are detailed on a technology-by-technology basis in **Tables 5-2** through **Table 5-25**; summarized by area in **Table 5-22** (SWMU Group A), **Table 5-23** (MPA) and **Table 5-24** (Site-wide Groundwater); and summarized for the overall Site in **Table 5-25.** **Table 5-25** shows the potential Corrective Action technologies that have been retained for more detailed analysis in Section 6.0. All of the potential Corrective Action technologies were appropriate for at least one of the three screening criteria, but the final determination to retain a particular Corrective Action technology was based on all three of the screening criteria listed above as well the ability of the technology to assist in attainment of Site CAOs. The results presented in **Table 5-25** were previously presented and discussed with the regulatory agencies prior to finalization.